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DIVIDENDS FROM WOOD RESEARCH

CURRENT SERIAL RECORDS

Recent Publications

January-June 1985

Instructions and Explanation

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer by the FPL Publications Section between January 1, 1985, and June 30, 1985.

Each publication listed in this brochure is available through at least one of the sources below. For each entry in the brochure, we indicate the primary source for that publication and show you how to obtain a copy:

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail the blank to FPL.

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Available through libraries (so indicated): Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed in this brochure within the following general categories:

- Adhesives
- Biotechnology
- Buildings and construction
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- Design data
- General
- Mycology
- Packaging
- Processing (drying, machining, sawing, gluing, grading)
- Pulp and paper
- Residues and energy
- Timber requirements and economics
- Wood materials

Adhesives

1. Relationship Between Chemical Characteristics of Phenol-Formaldehyde Resins and Adhesive Performance

Gollob, L.; Krahmer, R. L.; Wellons, J. D.; Christiansen, A. W. Forest Prod. J. 35(3): 42-48; 1985.

Selected resin formulations representing extremes in chemical characteristics were evaluated as adhesives either without additives (neat resins) or with blended extenders and fillers (mixed adhesives). These formulations were used to prepare parallel-laminated panels, which were subjected either to vacuum-pressure or boil-cycle aging. Both breaking load and percent of wood failure in shear were recorded. Estimated wood failure of specimens subjected to vacuum-pressure aging proved to be most useful for evaluating resin performance as a function of chemical characteristics.

Biotechnology

2. Characteristics and Adaptability of Some New Isolates of *Clostridium thermocellum*

Bender, Judith; Vatcharapijarn, Y.; Jeffries, T. W. Appl. Environ. Microbiol. 49(3): 475-477; 1985.

Six strains of *Clostridium thermocellum* isolated from various environments were characterized as to growth rate, production of reducing sugars, ethanol, and acetic acid from cellulose, base composition of DNA, and the abilities to adapt to ethanol and to grow at 45 °C. Five of the six new isolates produced 7% to 15% more ethanol and two produced about 45% more reducing sugars than a standard reference strain. One strain (MC-6) adapted more readily to growth in 2% ethanol than the others.

Changes in Structural and Chemical Components of Wood Delignified By Fungi

Blanchette, R. A.; Otjen, L.; Effland, M. J.; Eslyn, W. E. Wood Sci. Technol. 19: 35-46; 1985. (Copies available from R. A. Blanchette, Department of Plant Pathology, Stakman Hall, University of Minnesota, St. Paul, MN 55108; and through libraries. No charge.)

Cerrena unicolor, *Ganoderma applanatum*, *Ischnoderma resinosa* and *Poria medulla-panis* were associated with birch wood that had been selectively delignified in the forest. Preferential lignin degradation was not uniformly distributed throughout the decayed wood. A typical white rot causing a simultaneous removal of all cell wall components was also present. In the delignified wood, 95% to 98% of the lignin was removed as well as substantial amounts of hemicelluloses. Scanning and transmission electron microscopy were used to identify the micromorphological and ultrastructural changes that occurred in the cells during degradation. In delignified areas the compound middle lamella was extensively degraded causing a defibration of cells. The secondary wall, especially the S₂ layer, remained relatively unaltered.

3. Factors Involved in the Regulation of a Ligninase Activity in *Phanerochaete chrysosporium*

Faison, B. D.; Kirk, T. K. Appl. Environ. Microbiol. 42(2): 299-304; 1985.

The regulation of an H₂O₂-dependent ligninolytic activity was examined in the wood decay fungus *Phanerochaete chrysosporium*. The ligninase appears in cultures upon limitation for nitrogen or carbohydrate and is suppressed by excess nutrients, by cycloheximide, or by culture agitation. Activity is increased by idiophasic exposure of cultures to 100% O₂. Elevated levels of ligninase and, in some cases, of extracellular H₂O₂ production are detected after brief incubation of cultures with lignins or lignin substructure models, with the secondary metabolite veratryl alcohol, or with other related compounds. It is concluded that lignin degradation (lignin → CO₂) by this organism is regulated in part at the level of the ligninase, which is apparently inducible by its substrates or their degradation products.

4. Unstable Petite and Grande Variants of *Candida shehatae*

Jeffries, Thomas W. Biotechnol. Lett. 6(12): 777-782; 1984.

Two strains of *Candida shehatae* (ATCC 22984 and CSIR Y492) exhibit marked variability in colony size (petite, grande) and respiratory activity (tetrazolium reaction) when grown on glucose, xylose, and—especially—xylitol agar. The transitions occur in both directions at high frequency. Strains showing a negative or weak tetrazolium reaction on xylitol ferment xylose better than those showing a strong tetrazolium reaction. The type strain (ATCC 34887) shows stable colonial morphology with moderate respiratory and fermentative activities. This report demonstrates these variations.

5. Effect of Glucose Supplements on the Fermentation of Xylose by *Pachysolen tannophilus*

Jeffries, T. W.; Fady, J. H.; Lightfoot, E. N. Biotechnol. Bioeng. 27: 171-176; 1985.

In the presence of glucose, ethanol accumulates and growth is inhibited. Antonopoulos reported that the fermentation of xylose by *Fusarium* sp. is enhanced by the addition of glucose. In the case of *P. tannophilus*, Schneider reported enhanced ethanol yields during the fermentation of sugar mixtures. Since the authors thought that *P. tannophilus* was respiring significant quantities of ethanol under the aeration conditions employed, they decided to try to repress respiration through periodic additions of glucose. The objective of this research, therefore, was to improve the yield of ethanol from xylose through the addition of small amounts of glucose to the cultures. This technique significantly enhanced the yield of ethanol from xylose under aerobic conditions but it had no effect under anaerobic conditions, suggesting that respiration of ethanol was repressed.

6. The Ligninase of *Phanerochaete chrysosporium* Generates Cation Radicals from Methoxybenzenes

Kersten, Philip J.; Tien, Ming; Kalyanaraman, B.; Kirk, T. Kent J. Biol. Chem. 260(5): 2609-2612; 1985.

The hemoprotein ligninase of *Phanerochaete chrysosporium* catalyzes, in the presence of H₂O₂, a variety of seemingly different oxidations in lignin and lignin model compounds. The authors show that the enzyme also catalyzes the oxidation of various methoxybenzenes. ESR spectroscopy shows that the compounds are oxidized to aryl cation radicals. These decompose, evidently by H₂O addition. Thus 1,4-dimethoxybenzene is converted to *p*-benzoquinone and methanol. The authors propose a unified mechanism, based on formation of aryl cation radicals, to explain the various reactions catalyzed by the ligninase.

7. Biochemistry of the Oxidation of Lignin by *Phanerochaete chrysosporium*

Kirk, T. Kent; Tien, Ming; Faison, Brendlyn D. Biotechnol. Adv. 2: 183-199; 1984.

The objective of this research was to identify the biochemical agents responsible for the oxidative degradation of lignin by the white-rot fungus *Phanerochaete chrysosporium*. The authors examined the hypothesis that activated oxygen species are involved, and also sought the agent in ligninolytic cultures responsible for a specific oxidative degradative reaction in substructure model compounds. Results of studies of the production of activated oxygen species by cultures, of the effect of their removal on ligninolytic activity, and of their action on substructure model compounds support a role for hydrogen peroxide (H₂O₂) and possibly superoxide (O₂^{•−}) in lignin degradation.

8. Free Hydroxyl Radical Is Not Involved In An Important Reaction of Lignin Degradation by *Phanerochaete chrysosporium*

Kirk, T. Kent; Mozuch, Michael D.; Tien, Ming Biochem. J. 226: 455-460; 1985.

Hydroxyl radical (HO[•]) has been implicated in the degradation of lignin by *Phanerochaete chrysosporium*. This study assessed the possible involvement of HO[•] in degradation of lignin substructural models by intact cultures and by an extracellular ligninase isolated from the cultures. Two non-phenolic lignin model compounds [aryl-C_(ω)HOH-C_(ω)HR-C_(γ)H₂OH, in which R = aryl(β-1) or R = O-aryl(β-O-4)] were degraded by cultures, by the purified ligninase, and by Fenton's reagent (H₂O₂ + Fe²⁺), which generates HO[•]. The ligninase and the cultures formed similar products, derived via an initial cleavage between C_(ω-1) and C_(ω) (known to be an important biodegradative reaction), indicating that the ligninase is responsible for model degradation in cultures.

9. Lignin Biodegradation: The Microorganisms Involved and the Physiology and Biochemistry of Degradation by White-Rot Fungi

Kirk, T. Kent; Shimada, Mikio

In: Higuchi, T., ed. Biosynthesis and biodegradation of wood components. San Diego, CA: Academic Press; [1985]: Chapter 21.

Other chapters provide a summary of the chemistry of lignin degradation by white-rot fungi. The major purpose of this chapter is to build on that background to discuss the biochemistry of this degradation. As a complement to the biochemistry, the authors have also summarized the physiological features of lignin metabolism by the white-rot fungi.

Buildings and construction

10. Performance of a Press-Lam Bridge: A 5-Year Load-Testing and Monitoring Program

Gromala, David S.; Moody, Russell C.; Sprinkel, Michael M. USDA Forest Serv. Res. Note FPL-0251; 1985. 7 p.

This paper summarizes the results of load tests on an experimental highway bridge erected and put into service on the George Washington National Forest in Virginia in 1977. The bridge, made entirely of Press-Lam, a laminated veneer lumber (LVL) product, was load tested 1 month, 1 year, and 5 years after erection.

The bridge continues to perform quite well and, although a slight increase in bridge flexibility was noted during this time period, the deflections were well below those calculated in the original design. Thus, laminated veneer structural members can be successfully used in exterior structures.

11. Racking Deformations in Wood Shear Walls

McCutcheon, William J. J. Struct. Eng. 111(2): 257-269; 1985.

The theory presented in this paper predicts racking deformations in wood-stud shear walls. The energy method employed defines the wall performance in terms of the lateral nonlinear load-slip behavior of the nails which fasten the sheathing to the frame. Using power curves to define the nail load-slip relationship, the theory predicts that wall deformation due to nail slip will also be defined by a power curve. The theory also includes linear deformation caused by shear distortion of the sheathing material, and provides accurate estimation of wall performance up to moderate load levels. The method presented should be of interest to engineers who design light frame structures, to researchers, and to those who are concerned with building codes.

12. Seismic Performance of Low-Rise Light-Framed Wood Buildings

Soltis, L. A. Shock Vib. Dig. 16(11): 27-32; 1984.

This paper reviews literature on the performance of wood structures in earthquakes, examines component and building response, and discusses current design philosophy. Wood structures perform adequately when they are symmetric in plan and elevation and have adequate shear walls. Performance is bad when there is a lack of or nonsymmetric arrangement of racking walls.

13. Timber Availability for Crossties

Watterson, Irene A.

In: Rail Papers—1984.

Transportation Research Record 953. Washington, DC: Transportation Research Board, National Research Council; 1984: 18-21.

The consumption of wood products in the United States has increased during the past 20 years and is expected to increase further during the next 5 decades. At the same time, the area of commercial timberland has slowly decreased and is expected to decrease even further. With increasing numbers of railroad crossties being installed, the availability of timber for crossties is a concern to the transportation industry. This paper assesses that availability.

Chemistry

14. Bonding Wood Veneers with Cellulose Solvents

Conner, Anthony H.; River, Bryan H.; Lorenz, Linda F. J. *Wood Chem. Technol.* 4(4): 533-540; 1984.

Various solvent systems capable of dissolving cellulose have been reported in the literature. Cuene (cupriethylene diamine hydroxide) and FeTNa (ferric sodium tartrate) are well known examples. Preliminary experiments were conducted with Cuene and FeTNa to determine if the cellulose dissolving ability of these systems could be used to bond yellow birch veneers. The results indicate that relatively high dry shear strengths, and low wet shear strengths are obtained.

15. Factors Influencing Dilute Sulfuric Acid Prehydrolysis of Southern Red Oak Wood

Harris, J. F.; Scott, R. W.; Springer, E. L.; Wegner, T. H. In: Tillman, David A.; Jahn, Edwin C., eds. *Progress in Biomass Conversion*, v. 5. Orlando, FL: Academic Press; 1984: 102-141.

This report of hemicellulose removal from southern red oak provides new information on wood hydrolysis. Small scale studies with finely divided wood produced kinetic data on xylose removal and degradation. Direct steam heating of acidified wood chips in a small digester resulted in data more applicable to commercial operations.

16. Kinetics of Kraft Pulping of a Middle-Lamella-Enriched Fraction of Loblolly Pine

Obst, John R.
Tappi J. 68(2): 100-104; 1985.

The delignification rates in kraft pulping of loblolly pine wood and of crill, a middle-lamella-enriched fraction, were determined and found to be the same. Additionally, the crill could be delignified to the same low residual lignin as the wood. Analysis of kraft residual and dissolved lignins at various yields indicated that lignin from the middle lamella of loblolly pine and lignin from the whole wood were similar in methoxyl content. The kinetics of delignification are discussed.

17. Bonding of Toxic Chemicals to Wood

Rowell, Roger M.
Appl. Biochem. Biotechnol. 9: 447-453; 1984.

A series of chlorinated phenols, derivatives of pentachlorophenol and chlorinated benzene derivatives were prepared and their toxicity to the brown-rot fungi *Gloeophyllum trabeum* was determined in a standard ASTM 12-wk soil-block test. 2,3,5,6-Tetrachlorophenyl isocyanate and pentachlorophenyl isocyanate were synthesized, reacted with southern pine sapwood, and the extracted wood placed in the 12-wk soil-block test.

Pentachlorophenol was the tested chemical most toxic to *Gloeophyllum trabeum* in the soil-block test. Acetylation of pentachlorophenol does not reduce its toxicity.

18. Comparison of a Gravimetric CO₂ Method for Uronic Anhydride with a Colorimetric Method

Scott, Ralph W.; Libkie, Kimball A.; Springer, Edward L.
J. Wood Chem. Technol. 4(4): 497-504; 1984.

Colorimetry gave consistently lower uronic anhydride values for four species of wood than did measurement by evolved CO₂. These differences were partly related to CO₂ evolution from nonuronide wood extractives, and partly to CO₂ from nonuronide carbohydrates or lignin. After the usual benzene-ethanol extraction to remove interfering extractives, the uronic anhydride contents by gravimetric CO₂ analyses were still 30% to 40% higher than those by colorimetry. Based upon the greater selectivity of the colorimetric method, the authors conclude that colorimetry provides the more accurate uronic anhydride analyses of natural materials.

19. Resin Acids of Pinus Resinosa Needles

Zinkel, Duane F.; Clarke, Wilbur B.
Phytochemistry. 24(6): 1267-1271; 1985.

Historically, recovery of naval stores from the oleoresin has been nearly nonexistent, the only practical use having been as a waterproof sealer for birch bark canoes. Naval stores, however, are recovered from red pine wood as byproducts of kraft pulping.

As part of an evaluation of pine foliage as a potential source for naval stores and fine chemicals, the authors have investigated the diterpene resin acids of red pine needles. This paper reports on the unique composition of resin acids in red pine needles, on the isolation of two new labdane resin acids, and on specific implications of needle resin acid composition in genetic studies.

20. Major Resin Acids of Pinus Nigra Needles

Zinkel, Duane F.; Magee, Thomas V.; Walter, Jocelyn
Phytochemistry. 24(6): 1273-1277; 1985.

Labdane diterpene acids were found to be the major resin acid components in *Pinus nigra* needles of various seed sources. The major constituents have been identified as 4-epiimbricataloic acid, manoyl oxide 19-oic acid, 4-epicommunic acid, and 15-monomethyl pinifolate. A GC method was developed to analytically differentiate pinifolic acid from its monomethyl ester in an admixture of both compounds. A minor resin acid was identified as 18-acetoxy-8(17)-labden-15-oic acid. 10-Nonacosanol and isoabienol were identified as major constituents of the needle and cortex extractives, respectively.

Degradation and protection

21. Water-Dispersible Pentachlorophenol: A Preliminary Report on Field Tests With Southern Pine Stakes

DeGroot, Rodney C.

In: Proceedings, 1984 American Wood-Preservers' Association meeting; April 16-18; Dallas, Stevensville, MD: American Wood-Preservers' Association; 1984: 1-14.

The durability of southern pine sapwood stakes pressure treated with a water-dispersible pentachlorophenol is compared with that of stakes treated with oil-borne penta. Sets of treated stakes have been exposed in field plots in southern Mississippi for 18 and 30 months. Decay starts earlier in stakes treated with water-dispersible pentachlorophenol than in stakes treated to comparable retentions of oil-borne pentachlorophenol. Scores for decay and termite attack were analyzed with a nonparametric test. A statistically significant difference was detected only at the retention of 0.18 pcf (2.9 kg/cm), where stakes treated with the oil-borne pentachlorophenol performed better than stakes treated with water-dispersed pentachlorophenol. Further observation is needed to verify the relative performance of water-dispersible and oil-borne pentachlorophenol at retentions above 0.18 pcf (2.9 kg/cm). A distribution gradient for pentachlorophenol occurred in wood treated with water-dispersible pentachlorophenol.

22. SEM X-Ray Microanalysis of Pentachlorophenol in Tracheid Cell Walls of Southern Pine Sapwood

DeGroot, Rodney C.; Kuster, Thomas A.

Holzforschung. 38: 313-318; 1984.

Water-based formulations of pentachlorophenol ("penta") are being considered as lower-cost replacements for oilborne formulations of that preservative. The location of penta in cell walls may influence durability of treated products. The objective of this study was to determine whether the distribution pattern of waterborne penta in tracheid cell walls was equivalent to that of oilborne penta diluted with mineral spirits. SEM/EDXA was used to determine the distribution patterns in cell walls of southern pine sapwood. Relatively more penta entered and more uniformly penetrated cell walls with water-dispersible penta than with oilborne penta.

23. Bacteria and Accompanying Deterioration in River Pilings

Eslyn, Wallace E.; Moore, William G.

Mater. Org. 19(4): 263-282; 1984.

When a swinging drawbridge over the Milwaukee River was dismantled in 1974, 197 foundation pilings were found to have been supporting the stone block pier upon which the center of the bridge rested. From this array 14 red pine, 11 white pine, and 10 tamarack pilings, which had been totally submerged in river water for 85 years, were obtained for study. Samples removed from these pilings were used to determine: (a) piling strength losses, (b) the micro-organisms associated with the different piling tree species, and (c) the microscopical and chemical changes in representative piling sections. The effect of long-time submersion in river water on wood strength has already been reported. This report covers the findings pertaining to parts b and c above.

24. Longevity of Untreated Wood in Use Above Ground

Eslyn, Wallace E.; Highley, Terry L.; Lombard, Frances F.

Forest Prod. J. 35(5): 28-35; 1985.

Test crosses constructed from 12 different softwoods and 9 different hardwoods were exposed on a test fence for 9 to 12 years in both southern Mississippi and Wisconsin. Objectives of the test were to determine the aboveground longevity of these woods under varying climatic conditions and to identify the fungi associated with their deterioration. The woods tested in Mississippi were classified into aboveground decay resistance groups. The sapwood of lodgepole pine, basswood, balsam poplar, red alder, and sweetgum and the interior wood of sugar maple, yellow birch, and basswood decayed within an average of 7 years and were classified as nonresistant.

25. Weathering Interactions of Treated and Untreated Wood Surfaces

Feist, W. C.

In: Record of the 1984 Annual Convention of the British Wood Preserving Association; 1984 July 2-5; Cambridge [England]. London: British Wood Preserving Association; 1984: 13-23.

The primary objectives of the studies described in this report were to study the mechanism of outdoor weathering, and document the weathering performance of representative exterior finishing systems on various wood and wood-based substrates representing a selection of currently available traditional and newer siding materials. The effects of pretreatment/finish/substrate interactions and ultraviolet light-blocking characteristics were emphasized. These studies are currently in progress, and much of the data represent early findings of long-range exposure tests.

These studies clearly illustrate the enhanced protection found with two- and three-coat paint systems.

The Outdoor Finish: How and When to Paint or Stain

Feist, William

Fine Homebuilding. (6/7): 54-55; 1985. (Available through libraries.)

The author discusses the types of finishes or treatments used to protect wood surfaces from weathering. He also discusses when and how to paint or stain.

Design data

Influence of Changes In Allowable Stresses On Wood Truss Design

Galligan, William L.; McClellan, Phillip W.; Woeste, Frank E. Forest Prod. J. 35(5): 36-44; 1985. (Copies available from Frank E. Woeste, Engineering Department, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-7098. No charge.)

Sensitivity studies were conducted on wood truss design to determine the influence of changes in allowable properties on truss performance. The load duration factor was used as an example of a property modifier of contemporary interest. The sensitivity of metal plate wood truss design to changes in the factor was affected by the type and loading of the truss. In the "common" light-frame house truss, the influence of bending predominated over compression and tension, in that order. For trusses more lightly loaded on the bottom chord, tension was the most critical. Parallel chord trusses provided varying response; the 4 by 2 flat truss response paralleled that of the lightly loaded pitched truss, while the parallel chord roof truss exhibited a mixed response.

26. Time-dependent Bending Deflections of Douglas-fir 2 by 4's

Gerhards, C. C. Forest Prod. J. 35(4): 18-26; 1985.

The time-dependent deformation known as creep is an important material characteristic of wood that is not well understood. This study evaluates the time-dependent deflections of Douglas-fir 2 by 4 beams tested at three different constant load levels for up to 220 days. Few of the beams exhibited pure creep during the full time on test because most had partial fractures sometime during the experiment. Also, most of the beams failed completely during the experiment because the level of constant load was relatively high for their static strength.

27. A Hybrid/Finite Element Approach for Stress Analysis of Notched Anisotropic Materials

Gerhardt, T. D. J. Appl. Mech. 51: 804-810; 1984.

A hybrid/finite element is proposed to calculate stresses or stress intensity factors at notches, fillets, cutouts, or other geometric discontinuities in plane-loaded anisotropic materials. Stress and displacement fields assumed in the element satisfy all governing elasticity equations. Furthermore, the shape and stress-free conditions of the discontinuity are modeled exactly using conformal mapping and analytic continuation. Continuity of analytic and finite element displacement fields on the remaining element boundary are enforced in an approximate manner with a variational principle. Numerical results are presented for both elliptical void and circular fillet hybrid elements. Comparisons are made to analytic solutions. Results indicate that structural models using a hybrid element with a coarse conventional element mesh yield efficient and accurate calculations of critical stresses.

28. Light-Frame Wall Research—Axial and Bending Loads

Gromala, David S.; Polensek, Anton Housing Sci. 8(4): 383-393; 1984.

A computer-based finite element model was developed to predict the stiffness and strength of light-frame wood-stud walls under bending and compression loads. The model accounts for the contribution of the sheathing to composite action and to lateral load distribution. Material nonlinearities can be accommodated by an incrementally linear analysis. The model predicts wall performance to be sensitive to changes in stud properties and not highly sensitive to changes in properties of sheathing or fasteners.

29. A Microwave Method for Measuring Moisture Content, Density, and Grain Angle of Wood

James, William L.; Yen, You-Hsin; King, Ray J. USDA Forest Serv. Res. Note FPL-0250; 1985. 9 p.

Some properties that correlate in a generally useful way to strength are density, moisture content, and grain direction. This report gives a brief summary description of a microwave transmission method that shows promise for estimating rapidly and nondestructively these three factors for sawn lumber. These factors are essential if not sufficient for predicting with useful reliability the strength of a given structural piece. The objective of the research reported here was to develop the method and demonstrate its feasibility for in-line stress grading of structural lumber.

Mechanical Nonlinear Shear Wall Model

Naik, Tarun R.; Kaliszky, Sandor; Soltis, Lawrence A. J. Eng. Mech. 110(12): 1773-1778; 1984. (Copies available from American Society of Civil Engineers, 345 East 47th St., New York, NY 10017-2398. Paper No. 19314. \$1.)

Shear walls play a dominant role in the static and dynamic analysis and design of low-rise timber buildings.

This study describes a mechanical model which simulates the nonlinear behavior of a shear wall and aids in the construction of inexpensive models of entire shear wall buildings. Static and dynamic measurements obtained using these models can provide reliable results for shear wall buildings. Tests on these wall models will be useful to (1) Observe nonlinear behavior of the "parent" structure without having to conduct full-scale tests; (2) check the accuracy of linear analysis; and (3) verify the results of nonlinear analysis.

30. Airborne Sound Transmission Loss Characteristics of Wood-Frame Construction

Rudder, Fred F., Jr. USDA Forest Serv. Gen. Tech. Rep. FPL-43; 1985. 27 p.

This report summarizes the available data on the airborne sound transmission loss properties of wood-frame construction and evaluates the methods for predicting the airborne sound transmission loss. The first part of the report comprises a summary of sound transmission loss data for wood-frame interior walls and floor-ceiling construction. Data bases describing the sound transmission loss characteristics of other building components, such as windows and doors, are discussed.

The second part of the report presents the prediction of the sound transmission loss of wood-frame construction. Appropriate calculation methods are described both for single-panel and for double-panel construction with sound absorption material in the cavity.

31. Lateral Stability of Beams with Elastic End Restraints

Zahn, John J. J. Eng. Mech. 111(4): 500-511; 1985.

This paper analyzes the effect of elastic end axial-rotation (tip) restraint upon the buckling load of simply supported beams with shear stiffness of an attached deck taken into account. The deck is assumed to be "hinged" to the top edge of the beam, so that only its in-plane shear stiffness resists buckling.

In the design of large flat roof systems it is quite common for one beam of the system to be simply supported by adjacent beams connected in-line.

General

Forest Products Utilization

Fleischer, Herbert C.; Bulgrin, Erwin H.; Danielson, Jeanne P. In: Wenger, Karl F., ed. *Forestry Handbook*. 2d ed. New York: John Wiley & Sons; 1984: 565-635. (Complete book available from John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10016, \$49.95; article available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; \$10; ADA 154582.)

This chapter covers U.S. timber uses and trends, tree and wood nomenclature, wood growth, anatomy and identification, as well as wood chemistry, and physical and mechanical properties of wood.

Also explained are the many uses of wood and the operations utilized in the furthering of uses for wood and wood products.

Renovate an Old House?

Sherwood, Gerald E.

Home and Garden Bulletin No. 212. Washington, DC: U.S. Department of Agriculture, Forest Service. (Available from Superintendent of Documents, U.S. Government Printing Office, 710 N. Capitol Street, Washington, DC 20402; \$3.)

Many people consider renovating an old house, but is it possible, or would it be worthwhile? This bulletin suggests some points to weigh. Because many houses that might be candidates for rehabilitation are old houses of wood, much of the emphasis here is on wood structures. Emphasis is placed on how to view the house, from foundation to roof, and how to look for the condition of important items.

Mycology

32. Fifteen Little-Known Wood-Products-Inhabiting Hymenomycetes

Eslyn, Wallace E.; Nakasone, Karen K. *Mater. Org.* 19(3): 201-240; 1984.

The cultural characteristics, temperature-growth relations, and wood decay capacities of 15 little known products inhabiting Basidiomycetes were studied. Also studied were the chemical alterations accompanying their attack on wood. Optimum growth temperatures of these fungi ranged from about 22 °C for *Cystostereum pinicanadense* to 32 °C for *Crustoderma flavescens* and *Irpelex lacteus*. Growth inhibition occurred about 32 °C, except for fungi with optima of 28 °C or above, in which cases the inhibition levels were above 34 °C. *Cylindrobasidium album* was the only fungus that failed to decay wood in soil-block tests. Most of the fungi tested actively decayed wood, with a few strains equaling or exceeding the decay capabilities of the reference fungi, *Coriolus versicolor* and *Poria placenta*.

33. Micromorphology of Degradation in Western Hemlock and Sweetgum by the Brown-Rot Fungus *Poria placenta*

Highley, T. L.; Murmanis, L.; Palmer, J. G. *Holzforschung*. 39(2): 73-78; 1985.

The micromorphological changes in sweetgum and western hemlock caused by the brown-rot fungus *Poria placenta* are studied by transmission electron microscopy. Attack is predominantly initiated by hyphae growing in the cell lumen rather than by penetration. Hyphae are often attached to the wood cell wall by hyphal sheaths. The S₂ layer is intensely degraded while the S₃ layer remains relatively unattacked when attack is initiated from hyphae in the lumen. Occasionally intense degradation in localized areas of the middle lamella and cell corners occurs without noticeable degradation of the surrounding secondary wall.

Nitrogen Fixation Associated with Increased Wood Decay in Douglas-fir Residue

Jurgensen, M. F.; Larsen, M. J.; Spano, S. D.; Harvey, A. E.; Gale, M. R.

Forest Sci. 30(4): 1038-1044; 1984. (Copies are available from Institute for Scientific Information, 3501 Market Street, Philadelphia, PA 19104. Price unknown.)

Nitrogen fixation rates, as estimated by the acetylene reduction technique, were determined for four decay stages of down Douglas-fir logs on two old-growth sites in northwestern Montana. Acetylene reduction rates increased as wood decay progressed, but were not affected by site location. Wood carbohydrate, soluble sugar, total and soluble nitrogen, and moisture content also varied among decay stages. Acetylene reduction rates were positively correlated with wood moisture content and nitrogen concentration, and negatively correlated with carbohydrate level.

34. *Phellinus Bicuspidatus* (Hymenochaetales, Hymenochaetaceae), A New Species Associated With a White Sap Rot of Oak in Louisiana

Lombard, Frances F.; Larsen, Michael J. *Mycologia*. 77(1): 55-61; 1985.

A new wood-inhabiting basidiomycete, *Phellinus bicuspidatus*, is described from oak in Louisiana. Characteristics of the fruiting body and culture are presented and compared to those of *P. johnsonianus* and *P. spiculosus*. Key patterns and species codes are given for the three species.

35. Additional Species of *Crustoderma*

Nakasone, K. K.

Mycotaxon. 22(2): 415-418; 1985.

Two new combinations, *Crustoderma testatum* and *Crustoderma sabinicum*, are proposed. Basidiocarp and culture descriptions of *C. testatum* are included.

Fungi Associated with Decay in Treated Southern Pine Utility Poles in the Eastern United States

Zabel, Robert A.; Lombard, Frances F.; Wang, C.J.K.; Terracina, Fred

Wood Fiber Sci. 17(1): 75-91; 1985. (Copies are available from Robert A. Zabel, Department of Environmental and Forest Biology, SUNY, College of Environmental Science and Forestry, Syracuse, NY 13210. No charge.)

Approximately 1,320 fungi were isolated and studied from 246 creosote or pentachlorophenol-treated southern pine poles in service in the eastern United States. The fungi identified were Basidiomycete decayers, soft rotters, and microfungi. White rot fungi predominated in the 262 Basidiomycete decayers isolated from 180 poles. The major Basidiomycetes isolated by radial position from poles of varying service ages appeared to develop initially in the outer treated zones and were often associated with seasoning checks. Some decay origins, however, appeared to be cases of preinvasion and escapes of preservative treatment. Five species of soft rot fungi comprised nearly 85% of 211 isolates obtained from 131 poles. They were isolated primarily from creosote-treated poles in outer treated zones at the groundline.

Packaging

36. Measure Cushioning Values of Corrugated Pads

Liu, Jen Y.; Laundrie, James F.

Packaging. 30(1): 58-63; 1985.

Presently, 90% to 95% of all packaged products in the United States are shipped to consumers in corrugated containers. Typically, corrugated fiberboard serves to block the product in the container and act as a cushion to protect the product from shock damage. There are no known published articles that compare the cushioning properties of even the most common types of corrugated pads used to block and protect the products. This study presents some insight into this unknown area.

37. Vibrational Loading Mechanism of Unitized Corrugated Containers with Cushions and Non-Load-Bearing Contents

Urbanik, Thomas J.

Shock Vib. Bull., Part 3. Bull. 54; 1984 June: 111-122.

The use of hardwood and recycled fiber will no doubt increase as specifications for corrugated fiberboard containers change from material to performance standards. This report shows another way to accelerate this use by reducing the strength requirements of containers shipped in unitized loads. The rate of container deformation with top loading and the compliance of internal packing material or cushions are newly identified variables governing the compression of bottom containers.

The progressive deformation with top-loading of corrugated containers causes increasingly higher spring rates with a subsequent effect on dynamic loads. Cushions or internal packing provide a natural ability to absorb vibrations to a degree, depending on their spring rates relative to the containers.

38. Deckboard Bending Theory for Three-Stringer Wood Pallets in Drive-In Racks

Urbanik, Thomas J.

J. Test Eval., JTEVA. 13(1): 3-8; 1985.

Wood pallets are increasingly being used in drive-in racks and are often positioned for easy access with supports parallel to the outer stringers. The performance of these pallets is governed by the bending behavior of the deck-boards as affected by the distribution of the load and the rigidity of the nailed joints. This report gives design formulas for calculating the shortterm constant environmental condition bending stiffness and bending strength of three-stringer pallets used in racks.

Processing

39. The Veneer Mill Improvement Program

Danielson, Jeanne D.
Interfaces. 14: 59-66; 1984.

At each step of veneer manufacture, from the forest through the veneer mill, mechanical and human errors reduce the amount of veneer recovered. The Veneer Mill Improvement Program (VIP), developed at the Forest Products Laboratory, is a procedure to measure raw material conversion efficiency in softwood veneer mills and a computer model to predict the effect of processing improvements. Three areas are analyzed in a VIP study: log bucking, block centering in the lathe, and veneer peeling and clipping. VIP is used to identify sources of veneer losses and its results are used to troubleshoot in the mill.

40. Use of Acoustic Emissions to Control Drying Rate of Red Oak

Honeycutt, Robert M.; Skaar, Christen;
Simpson, William T.
Forest Prod. J. 35(1): 48-50; 1985.

As wood dries and shrinks, small internal fractures occur because of drying stresses. These fractures result in acoustic emissions that can be amplified and detected for use in kiln control. They can serve as an early warning signal for larger fractures that would be considered drying defects. The research reported in this paper demonstrates that the rate of acoustic emissions can be used to control temperature and relative humidity in a drying compartment.

41. Balanced Saw Performance

Lunstrum, Stanford J.
Tech. Rep. 12. Madison, WI: U.S. Department of Agriculture,
Forest Service, Forest Products Utilization; 1985. 17 p.

Experience has taught most sawmillers which saws to choose for specific applications. However, for correct saw selection and saw operation, it is possible to mathematically calculate the variables involved. Program "SAW" has been developed to integrate these variables quickly and accurately. Operators who use Program "SAW" will be able to (1) maximize production from their saws, (2) reduce saw operating problems, (3) maximize saw life, and (4) increase recovery efficiency by producing more accurately sized lumber.

42. Evaluation of Mixed Hardwood Studs Manufactured by the Saw-Dry-Rip (SDR) Process

Maeglin, Robert R.; Boone, R. Sidney
USDA Forest Serv. Res. Note FPL-0249; 1985. 10 p.

The Saw-Dry-Rip (SDR) process for manufacturing structural lumber (studs) from hardwoods has great potential for providing a quality product, reducing shipping costs, and relieving pressure on the softwood resource. However, getting enough logs of a given species from the operating area of a mill may be a problem.

The purpose of this study is to evaluate three species frequently found growing in mixture with the four major species already evaluated for production using SDR, i.e. yellow-poplar, aspen, cottonwood, and paper birch. The three new species considered are basswood, red maple, and black willow. The evaluation is to see if SDR will reduce the amount of warp normally expected with conventional processing of these three species. Basswood, red maple, and black willow are found throughout much of the eastern U.S. and when combined with the other low- and medium-density hardwoods provide an expanded resource base and an excellent economic opportunity for many mills.

43. Process for Rapid Conversion of Red Oak Logs to Dry Lumber

Simpson, William T.
Forest Prod. J. 35(1): 51-56; 1985.

Lumber is usually air- and kiln-dried in batch processes that take several weeks or months to complete. Processing costs are, therefore, high because of the expense of holding large lumber inventories during this long drying period. This paper describes a promising process for converting red oak logs or bolts to dry, 1-inch-thick lumber in several hours instead of the usual several weeks. The key to the process is a combination of sawing pattern and press drying that allows rapid drying with a minimum of drying defects. The most common drying defect that develops in press drying is honeycomb cracks caused by internal tension forces that develop as wood dries and shrinks.

44. Press Drying Quartersawn Hard Maple Lumber

Simpson, William T.
Forest Prod. J. 35(4): 31-32; 1985.

This note describes application of a press drying process to quartersawn hard maple. The success of the process depends on the ability of the compression of the press to counteract and suppress internal drying tension that causes honeycomb. Press drying was at 350 °F platen temperature and at 75 to 125 psi platen pressure. Sapwood dried with only a small amount of honeycomb. Heartwood, however, developed severe honeycomb, ring failure, collapse, and surface cracks during press drying.

45. Empirical Equations for Estimating Drying Times of Thick Rotary-Cut Veneer in Press and Jet Dryers

Tschernitz, John L.
USDA Forest Serv. Res. Pap. FPL 453; 1985. 16 p.

This paper describes the use of empirical equations for the analytical correlation of the drying variables—time, temperature, green thickness, and moisture content—for drying southern pine and Douglas-fir thick-cut veneers in two dryer types.

46. FPL Design for Lumber Dry Kiln Using Solar/Wood Energy in Tropical Latitudes

Tschernitz, John L.; Simpson, William T.
USDA Forest Serv. Gen. Tech. Rep. FPL-44; 1985. 17 p.

The low-cost solar/wood energy lumber dry kiln described in this report was designed and tested by the Forest Products Laboratory (FPL) for such countries where solar dry kilns can be built and operated at low cost.

The FPL design is for a 6,000-fbm capacity kiln having an insulated drying compartment, an external horizontal solar collector, and a furnace room containing a wood burner. Capacities larger or smaller than 6,000 fbm are also possible. This design allows collector and wood burner sizing to match the energy demands of the dryer. The design also incorporates low-cost controls that allow unattended drying when operated as a solar-only dryer. Manual firing is necessary when the wood-burning system is supplying the energy.

Pulp and paper

The Effect of Whitewater Recycle on Paper Strength Properties

Dullforce, J. P.

Miami University, Oxford, OH, 1984, Master of Science Thesis, 113 p. (Copies available from University Microfilms International, Ann Arbor, MI 48106; \$35 soft cover, \$21.50 microfilm.)

Environmental factors and various papermaking benefits have led to increased whitewater recycle by most mills. This has resulted in a buildup of dissolved and suspended solids in the process water. This study investigated the effect of dissolved solids on paper strength, the objectives being to (1) determine if inorganic or organic contaminants have the greater detrimental effect on sheet strength, (2) quantify the effect of the individual contaminants on sheet strength and to determine the mechanism of strength loss of the most damaging contaminants, and (3) determine the interaction between the inorganic and organic contaminants. Methods by which the variables could be measured were determined and used in the analysis of the mechanisms of the strength losses observed.

Mechanism for Control of Retention and Drainage in Closed Whitewater Systems

Noe, J. S.

Miami University, Oxford, OH, 1984, Master of Science Thesis, 204 p. (Copies available from University Microfilms International, Ann Arbor, MI 48106; \$35 soft cover, \$21.50 microfilm.)

Controls on effluents, accompanied by attractive cost savings, has moved the paper industry toward ever-increasing degrees of whitewater reuse. As a result, dissolved organic and inorganic contaminants build up in the recycled whitewater. An instrument-based retention control strategy to detect and maintain control over these contaminants is discussed. The ability of total organic carbon and specific conductance were studied to monitor dissolved contaminant levels. The aim of this project was to examine this area and evaluate the most effective type of low molecular weight, high charge density cationic polymer to use in a closed mill environment. Total organic carbon and specific conductance were studied with respect to their ability to specifically imply dissolved organic and inorganic concentrations, respectively, and were found to be quite effective.

Fiber Deflocculation

Sethna, R. H.

University of Wisconsin-Madison, WI, Master of Science Thesis, 1984, 112 p. (Copies available from University Microfilms International, Ann Arbor, MI 48106; \$35 soft cover, \$21.50 microfilm.)

A Couette-type system was used to investigate the deflocculation of medium solids pulp slurries. Two designs were considered: (1) A semi-batch unit in which an initial charge of slurry was sheared and the separated fibers removed by elutriation, and (2) a continuous unit to which slurry was continuously fed. The former design, while ensuring good product quality led to low fiber concentrations. The latter design gave both good product quality and high fiber concentrations.

47. A Mechanistic Perspective of the Biaxial Strength of Paperboard

Gunderson, Dennis E.; Bendtsen, Lee A.; Rowlands, Robert E. In: Invited papers presented at the spring 1984 meeting of Empire State Paper Research Associates, Inc.; 1984 May 21-24; Wisconsin Rapids, WI. Syracuse, NY: Empire State Paper Research Institute, State University of New York, College of Environmental Science and Forestry; 1984: 54-85.

Prior research has demonstrated the practical significance of biaxial strength and established methods for measuring and predicting biaxial properties. Analytical models have been shown to accurately predict failure conditions, but do not identify the mode of failure. The present research develops a method for modeling the biaxial strength of

paperboard based on criteria which infer a specific mechanism or mode of failure. In this approach, one or more criteria comprise a model which is evaluated iteratively at multiple states of stress to construct a failure envelope. Analytical results are graphically compared with experimental data.

48. A Device for Compressing Paperboard Edgewise in the SEM

Sachs, I. B.

J. Phys. E: Sci. Instrum. 18: 101-102; 1985.

The scanning electron microscope (SEM) can be used to study the failure mechanism of paperboard in a dynamic mode because of its depth of focus and range of magnification. In addition, its fast observation time and high resolution should allow quick and easy inspection of failure of the paperboard under edgewise compression. To observe and record changes using an SEM, however, the paperboard sample must be in the electron beam while it is being compressed. Therefore, a small testing device for use in the SEM is needed as a tool for characterizing and identifying the failure mechanism. In this report, the author describes such a testing device, designed and built at the Forest Products Laboratory, that can hold a paperboard sample in the SEM electron beam while being compressed edgewise.

49. Preserving and Recovering Pulp Fibrils Subsequent to Drying

Sachs, Irving B.

Pap. Technol. Ind. 26(1): 38-41; 1985.

Fibrils and microfibrils act as bonds between fibres leading to greater strength of paper and paperboard. When fibres dry, however, these fibrils and microfibrils dry down onto the surface of the fibre. These dried-down elements appear to be unavailable for fibre bonding during subsequent papermaking processes using recycled fibre or dried market pulp. The present study was conducted to determine a drying method by which fibrils and microfibrils can be preserved upon drying or recovered after rewetting. Never-dried softwood and hardwood kraft fibres were dried in air, dried on a paper machine, freeze dried, and critical point dried. The never-dried fibres that were critical point dried retained many fibrils and microfibrils compared to those that were freeze dried, air dried, or paper machine dried. Never-dried fibres that were air dried, rewet, and then critical point dried recovered many dried down fibrils and microfibrils.

50. FPL Spaceboard—A New Structural Sandwich Concept

Setterholm, Vance C.

Tappi J. 68(6): 40-42; 1985.

Experimental research with the goal of better support for structural sandwich facing and more efficient use of fiber led to the concept called "FPL Spaceboard." In this concept, the core component and facing component for each half of the sandwich are formed in a single pulp-molding process. The core density is nonlinear, with highest density and support closest to the facing. The core design is cellular and can be wafflelike in appearance. FPL Spaceboard components can be strengthened by press drying or resin treatment. Whereas the original concept and experimentation was aimed at the same applications as those of corrugated fiberboard, it was immediately apparent that the FPL Spaceboard concept would have even broader impact and potential for a wide variety of structural sandwich designs.

51. The Effects of Closed White Water System Contaminants on Strength Properties of Paper Produced From Secondary Fiber

Springer, Allan M.; Dullforce, Jon P.; Wegner, T. H.
Tappi J. 68(4): 78-82; 1985.

Increased white water recycling has resulted in a buildup of organic and inorganic contaminants in the white water. This study examined the effects of these white water contaminants on the strength properties of paper produced from secondary fiber. Eight contaminant types were evaluated at three concentrations. The effects of these contaminants, grouped as organic and inorganic, were measured first, followed by separately determining the effects of individual contaminants. As a group, the organic contaminants had a greater effect in reducing sheet tensile index.

Tensorial Strength Analysis of Paperboard

Suhling, J. C.; Rowlands, R. E.; Johnson, M. W.;
Gunderson, D. E.
Exp. Mech. 1985 March: 75-84. (Available from Information Services Division, Kurt F. Wendt Library, College of Engineering, University of Wisconsin-Madison, 215 North Randall Avenue, Madison, WI 53706; \$5.)

Tensorial-type failure criteria with linear and quadratic terms are used to calculate the strength of paperboard under plane stress. Theoretical predictions and experimental data are correlated in all four quadrants of biaxial normal stress with various levels of shear. Several methods are examined for determining the interaction coefficient F_{12} . Comparisons are made with optimum values obtained from least-squares analyses.

Residues and energy

52. Forest Service Energy Research Overview

Zerbe, John I.

In: Proceedings of the 5th annual solar and biomass energy workshop (including wind); 1985 April 23-25; Atlanta, GA. [Tipton, GA]: U.S. Department of Agriculture, Science and Education, Southern Agricultural Energy Center; 1985: 31-34.

The author gives an overview of energy research and other related research projects.

Timber requirements and economics

Employment in Minnesota's Wood-Based Industry: A Shift-Share Analysis

Bilek, Edward M.; Ellefson, Paul V.
Staff Paper Series Number 46. College of Forestry and the Agricultural Experiment Station, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, St. Paul, MN; Sept. 1984. (Available from Department of Forest Resources, College of Forestry and the Agricultural Experiment Station, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, St. Paul, MN 55108. No charge.)

The analysis focused on employment movements within Minnesota's wood-based industry and compared them with movements in the wood-based industry nationwide and with employment in all U.S. manufacturing industries.

Econometric Versus Univariate and Bivariate Time-Series Forecasts: The Case of Softwood Lumber Imports

Buongiorno, Joseph; Brannman, Lance; Bark, Taeho Forest Sci. 30(1): 194-208; 1984. (Available from Joseph Buongiorno, School of Forestry, University of Wisconsin, Madison, WI 53706. No charge.)

An econometric model based on housing starts, prices, and past imports; a univariate time-series model using past imports only; and a bivariate time-series model of imports and housing starts were used to forecast United States softwood lumber imports. Experiments were performed to test the forecasting accuracy of each model assuming either perfect knowledge of the future value of determining variables, or complete ignorance. These experiments were repeated to forecast 1 month or 3 months ahead. The results suggest that the bivariate time-series model based on lumber imports and housing starts was the most useful from the point of view of pure forecasting.

A Model of International Trade of Forest Products, With An Application to Newsprint

Buongiorno, Joseph; Gilles, J. Keith
J. World Forest Resour. Manage. 1: 65-80; 1984. (Available from Joseph Buongiorno, School of Forestry, University of Wisconsin, Madison, WI 53706. No charge.)

An econometric model of the international trade of forestry commodities was developed and applied to newsprint. Given functions describing demand and supply in each country, trade flows and equilibrium prices in any given year were determined by assuming a competitive market for forest products. This was done by an algorithm that maximized the surplus value of world trade for every year throughout the projection period. Constraints were used to reflect various barriers to trade and inertia.

Forecasting the Price of Lumber and Plywood: Econometric Model Versus Futures Markets

Buongiorno, Joseph; Huang, F. Mey; Spelter, Henry
Forest Prod. J. 34(7/8): 13-18; 1984. (Available from Joseph Buongiorno, School of Forestry, University of Wisconsin, Madison, WI 53706. No charge.)

Three methods of forecasting the price of lumber and plywood were compared: 1) the FORSIM model of Data Resources Inc., 2) the futures markets, with prices of contracts for future delivery used as forecasts of cash prices, and 3) a naive model where the predicted price is equal to the last known cash price. The comparisons used data for the period 1974 to 1981. For lumber forecasts of the current quarter and one quarter ahead there was no significant difference in accuracy between the FORSIM and futures market. For two and three quarters ahead, FORSIM was better. For all horizons, FORSIM and the futures market were more accurate than the naive model.

Demand Functions for United States Forest Product Exports to the European Economic Community

Chou, Jieh Jen; Buongiorno, Joseph Wood Fiber Sci. 16(2): 158-168; 1984. (Available from Joseph Buongiorno, School of Forestry, University of Wisconsin, Madison, WI 53706. No charge.)

The European Economic Community (EEC) is becoming an increasingly important market for United States forest products. Prediction of the future size of this market requires a quantitative assessment of the responsiveness of demand with respect to United States prices, the price of products from other countries, and major demand shifters with the EEC. To determine these elasticities, a theoretical dynamic demand model was developed. The model was estimated for each one of seven major groups of United States products sold in the EEC: softwood lumber (SITC 243.2), hardwood lumber (SITC 243.3), pulp and waste paper (SITC 251), veneer sheets (SITC 631.1), plywood (SITC 631.2), newsprint paper (SITC 641.1), and other paper and paperboard (SITC 641 excluding 641.1). Analysis of covariance was the estimation procedure used, based on pooled time series from eight EEC countries observed during the period 1961 to 1977.

An Interregional Analysis of the North American Newsprint Industry

Guder, Faruk; Buongiorno, Joseph Interfaces. 14(5): 85-95; 1984. (Available from Joseph Buongiorno, School of Forestry, University of Wisconsin, Madison, WI 53706. No charge.)

An interregional analysis of the newsprint industry in the United States and Canada was performed in order to develop a model that would represent accurately the behavior of the industry in terms of regional demand, supply, prices, and transportation of newsprint and attendant raw materials. This model was used to make long-term projections of newsprint production, consumption, manufacturing capacity, and prices based on a specific scenario for future economic and demographic growth. These kinds of forecasts are useful in long-term strategic planning to help firms foresee the evolution of the markets within which they operate.

Trends in U.S. Wood-Based Industrial Technology: An Evaluation of Assigned Patents

Margl, Richard A.; Ellefson, Paul V. Staff Paper Series Number 50. College of Forestry and the Agricultural Experiment Station, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, St. Paul, MN; May 1985. (Available from Department of Forest Resources, College of Forestry and the Agricultural Experiment Station, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, St. Paul, MN 55108. No charge.)

Trends in technology as reflected by evaluation of patents assigned to selected wood-based firms were evaluated in two fashions, namely, a patent classification approach and a defined category approach. Many of the trends identified by the former were matched with parallel results from the latter. The obvious instances of such correlation are identified for each corporate division.

53. Harvesting/Manufacturing Computer Software Overview

Harpole, George B.

In: Cooney, T. M., ed. Forestry in a brave new world: Proceedings of a computer symposium/1st annual meeting of the Forest Resources Systems Institute; 1984 March 19-21; Knoxville, TN. Florence, AL: Forest Resources Systems Institute; 1984: 25-27.

Characteristics, benefits and potential applications of five timber harvesting and five wood products manufacturing programs are presented. The programs are available from USDA Forest Service, Northeastern Area State and Private Forestry, 1992 Folwell Ave., St. Paul, MN 55108.

54. Internal Rate of Return May Be Used to Define Initial Equity for Composite Rate-of-Return Analyses

Harpole, George B.

Forest Sci. 30(4): 1096-1102; 1984.

A project's internal rate of return (IRR) may be used to define an initial equity amount (IEA) which will yield a composite rate of return (CRR) approximately equal to the IRR of the project under a wide range of different intermediate borrowing (I_b) and reinvestment rates (I_r). Initial equity investment determines requirements for borrowing, as well as cash surpluses that become available for reinvestment. Consequently, there is always a unique IEA that will establish circumstances for normal projects where net interest is equal to zero for $I_b = I_r = 0$ or IRR, and is close to zero for $I_b = I_r > 0$, and $< \text{IRR}$.

55. Investment Limits for Small-Scale SDR and EGAR Sawmills

Harpole, George B.

USDA Forest Serv. Res. Pap. FPL 454; 1985. 11 p.

Market prices, roundwood costs, and other operating factors are used to formulate algorithms that may be used for estimating investment limits for small-scale SDR (Saw-Dry-Rip) and EGAR (Edge-Glue-and-Rip) sawmills. Algorithms are derived from results of discounted cash flow analyses approximating mills producing between 6 million and 12 million board feet per year (two-shift basis). The equations presented provide an approximating method which can be useful for assessing economic potentials for totally new mills, or modification of existing mills for production of SDR or EGAR lumber, and can be expected to be useful for structuring more detailed analyses for final assessments.

56. Demographic Factors Influencing Future Forest Resource Demands and Policy

Marcin, Thomas C.; Skog, Kenneth E.

In: Forest resources management—The influence of policy and law: Speeches and papers; [1984 August 6-7;] Quebec [ON, Can.]. Quebec: International Forest Congress; 1984: 279-283.

The trend toward zero population growth in the United States, the general aging of our population, and the passage of the large, socially influential baby boom generation through various life stages to retirement will mean changing social concerns about forest resource use. We suggest these may include (1) declining household formations and a resulting decline in use of wood for new housing, (2) cycling interest in harvesting from nonindustrial private land, and (3) increasing scrutiny of certain management practices on public forest land. The future also appears to hold an uncertain quality of life for a much larger group of older Americans.

57. An Improved Method for Measuring the Volume of Large Wooden Objects

McKeever, David B.; Burns, Marvin; Thomas, Jerome

Forest Prod. J. 35(1): 33-35; 1985.

A water displacement specific gravity procedure, previously developed at the Forest Products Laboratory, was modified and used to measure the volume of solid wood in pallets. The procedure is inexpensive, efficient, and accurate. It can be adapted readily to measure the wood content of any large, irregularly shaped wooden object and, as such, is useful for researchers and wood products manufacturers.

58. A Profile of Wood Use in Nonresidential Building Construction

Spelter, Henry; Anderson, Robert G.

USDA Forest Serv. Resour. Bull. FPL 15; 1985.

This report presents estimates of the amounts of lumber, glued-laminated lumber, trusses, plywood, particleboard, hardboard, and wood shingles used in new nonresidential building construction in the United States. Use of wood products is shown for several building types, project sizes, and building components.

Wood materials

59. Evaluation of Black Locust (*R. pseudoacacia*) as Raw Material for Wet-Process Hardboard

Carll, C.; Eslyn, W.; Myers, G.; Brewer, W.; Staton, D. Forest Prod. J. 35(3): 11-17; 1985.

Wet-process hardboards were made from fiber from small, whole black locust (*R. pseudoacacia*) stems (including bark) and from pure locust heartwood. Heartwood extractives were apparently stem-extracted and lost to cyclone condensate during digesting. Despite this apparent loss of extractives, the hardboards showed good resistance to weight and strength losses caused by the decay fungi *C. versicolor* and *G. trabeum*. Dry mechanical properties of all locust boards were acceptable. Dimensional stability properties of boards from pure heartwood were good, but the boards from whole stems showed considerable moisture absorption in exposure to high humidity, and corresponding excessive thickness swelling. These boards from whole stems showed poor exterior durability.

Mechanical Fastener Performance in Reconstituted Structural Wood-Base Panel Products

Chow, Poo; McNatt, J. Dobbin; Gertner, George Z.; Janowiak, John J. (Copies available from Department of Forestry, Illinois Agricultural Experiment Station, University of Illinois, Urbana, IL 61801. No charge.)

In this study the lateral nail (and staple) resistance of waferboard, OSB, plywood, hardboard, and composite plywood were evaluated under three conditions: dry, wet, and after accelerated aging. Three test methods were compared for determining lateral nail resistance.

Accelerated Aging of Wood-Based Panel Products: A Review and Commentary

Gillespie, Robert H. In: Price, Eddie W., ed. Proceedings of a workshop on the Durability of Structural Panels; 1982 October 5-7; Pensacola, FL. Gen. Tech. Rep. SO-53. New Orleans, LA: U.S. Department of Agriculture, Forest Service; 1984: 11-26. (Complete proceedings available from Publications Services, USDA, Forest Service, Southern Station, U.S. Postal Service Bldg., 701 Loyola Ave., New Orleans, LA 70113. No charge.)

This report reviews how accelerated-aging procedures were developed to evaluate the durability potential of wood-based materials. It traces the development of accelerated-aging back to concerns about paper for library or archival storage and includes the procedures subsequently developed for wood, adhesives, plywood, particleboard, flakeboard, and other wood-based panel products. Viewing these procedures in the perspective intended by the original investigators should lead to a better understanding about their use and the information they provide and, thereby, guide and stimulate further developments in this area of research.

Preservative Treatment Effects on Mechanical and Thickness Swelling Properties of Aspen Waferboard

Hall, Henry J.; Gertjeansen, Roland O.; Schmidt, Elmer L. In: Price, Eddie W., ed. Proceedings of a workshop on the Durability of Structural Panels; 1982 October 5-7; Pensacola, FL. Gen. Tech. Rep. SO-53. New Orleans, LA: U.S. Department of Agriculture, Forest Service; 1984: 143-152. (Complete proceedings available from Publications Services, USDA Forest Service, Southern Station, U.S. Postal Service Bldg., 701 Loyola Ave., New Orleans, LA 70113. No charge.)

Eighteen liquid or powdered phenolic resin-bonded types of aspen (*Populus tremuloides* Michx.) waferboard were manufactured incorporating eight commercially manufactured and one experimental preservative. Preservatives were applied by pretreating wafers, incorporating them with wax or resin at the time of furnish preparation, or by dipping or pressure treating finished panels.

Testing was conducted before and after accelerated aging, as outlined by the American Society for Testing and Materials standard method D 1037.

Isocyanate Bonded Medium Density Fiberboard

Johns, William E.; Myers, Gary C.; Lentz, Martin T.; Huffaker, E. Max; Saunders, John B.

In: Maloney, Thomas M., ed. Proceedings of the 18th Washington State University International Particleboard/Composite Materials Series Symposium; 1984 March 27-29; Pullman, WA. [Pullman, WA]: Washington State University; 1984: 101-116. (Available from Information Services Division, Kurt F. Wendt Library, College of Engineering, University of Wisconsin-Madison, 215 North Randall Avenue, Madison, WI 53706; \$5.)

Medium-density fiberboard was prepared with isocyanate binder. Several boardmaking variables were examined. Panels prepared with 6% resin at 10% moisture content yielded acceptable strength properties, but unacceptable linear expansion values. Mat moisture content and press closing rates were also found to be significant.

60. Performance of Oak-Cottonwood Plywood Bonded with a Softwood Plywood Phenolic During 10 Years of Exterior Exposure

Jokerst, R. W. Forest Prod. J. 35(4): 27-30; 1985.

This work was started in 1972 to demonstrate that hardwoods could be used to extend the raw material base for construction plywood. To demonstrate the suitability of hardwoods, plywood panels were fabricated from northern red oak and eastern cottonwood. The adhesive used was a commercial phenolic resin, used for southern pine plywood. The panels were placed on exterior exposure at Madison, WI, and samples were withdrawn and tested over a 10-year period.

61. Rate- and Duration-of-Load Behavior of Lab-Made Structural Flakeboards

McNatt, J. Dobbin USDA Forest Serv. Res. Note FPL-0252; 1985.

Tests of structural use panels under different loading conditions provide basic information for establishing design stresses. This paper reports the effects of loading rate in tension and bending and of duration of load in tension on the properties of four lab-made structural flakeboards (two of which had aligned flakes). The objective was to determine if these panels—made from larger, engineered flakes—behaved the same as commercial particleboards—made primarily from planer shavings and sawdust—that were evaluated in an earlier study. For specimens loaded to failure at different rates of deformation, strength decreased 12% in tension and 8% in bending with each tenfold increase in time to maximum load. Modulus of elasticity decreased 4% to 5%. For specimens loaded in tension at constant stress levels from 50% to 90% of static strength, time to failure increased tenfold with each 8% decrease in stress. These results for the lab-made structural flakeboards are essentially the same as those reported earlier for commercial particleboards.

How Cyclic Humidity Affects Static Bending and Dimensional Properties of Some Wood-Base Panel Products

McNatt, J. Dobbin

In: Price, Eddie W., ed. Proceedings of a workshop on the Durability of Structural Panels; 1982 October 5-7; Pensacola, FL. Gen. Tech. Rep. SO-53. New Orleans, LA: U.S. Department of Agriculture, Forest Service, 1984: 67-76. (Complete proceedings available from Publications Services, USDA Forest Service, Southern Station, U.S. Postal Service Bldg., 701 Loyola Ave., New Orleans, LA 70113. No charge.)

This study evaluates the effects of cyclic humidity and length of exposure time during cycling on the dimensional and static bending properties of various wood-base panel products. Five different wood-base panel types were evaluated for bending strength and stiffness and dimensional changes after exposure to different numbers of cycles (1, 3, 6, or 12) of 30% to 90% relative humidity. Panel types were selected from those most likely to undergo repeated high-low humidity conditions during service: fiberboard sheathing, hardboard siding, particleboard mobile home floor decking, particleboard factory-built house floor decking, and waferboard.

Design of a Laboratory Particleboard Mat-Forming and Conveying System

Pellerin, Roy F.; Ross, Robert J.; Geimer, Robert L.; Nilson, Nils A.

Forest Prod. J. 35(6): 17-18; 1985. (Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705; \$2 each, with \$5 minimum, plus 10% postage and handling.)

A particleboard mat-forming and conveying system has been designed and built which will handle a wide variety of furnish sizes and shapes. It consists of a conveying line, a mat-forming head, and a continuous mat weighing mechanism. Mats with uniform density have been produced from a wide variety of particle geometries including drum-cut wafers, disk-cut flakes, ring-cut flakes, hammer-milled particles, and planer shavings. The ability to form mats from such varied furnishes makes the system very useful in a laboratory setting.

62. End Jointing of Laminated Veneer Lumber for Structural Use

Youngquist, J. A.; Laufenberg, T. L.; Bryant, B. S.
Forest Prod. J. 34(11/12): 25-32; 1984.

This study was divided into three phases. Phase I evaluated the processing variables of veneer grade, veneer thickness, and LVL width on the mechanical properties of 3/4-inch Douglas-fir laminated veneer lumber (LVL). Phase II involved study of vertical and horizontal finger joints and plain scarf joints in panel-length 3/4-inch LVL and their performance under tensile loading. Phase III considered jointing and face laminating of 3/4-inch (nominal 1-in.) material to produce 1-1/2-inch (nominal 2-in.) LVL with offset scarf and a three-stage—or folded—scarf joint.

No attempt was made to develop design properties for any material in this study. Sample sizes were selected for assessment of technical feasibility of producing high-strength LVL using plywood and glued-laminating (glulam) facilities.

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